

# INTERNATIONAL STANDARD

## NORME INTERNATIONALE



**Passive filter units for electromagnetic interference suppression –  
Part 2: Sectional specification – Passive filter units for which safety tests are  
appropriate – Test methods and general requirements**

**Filtres passifs d'antiparasitage –  
Partie 2: Spécification intermédiaire – Filtres passifs pour lesquels des essais de  
sécurité sont appropriés – Méthodes d'essai et exigences générales**



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**Passive filter units for electromagnetic interference suppression –  
Part 2: Sectional specification – Passive filter units for which safety tests are  
appropriate – Test methods and general requirements**

**Filtres passifs d'antiparasitage – IEC 60939-2:2005  
Partie 2: Spécification intermédiaire – Filtres passifs pour lesquels des essais de  
sécurité sont appropriés – Méthodes d'essai et exigences générales**

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## INTERNATIONAL ELECTROTECHNICAL COMMISSION

**PASSIVE FILTER UNITS FOR ELECTROMAGNETIC  
INTERFERENCE SUPPRESSION –****Part 2: Sectional specification –  
Passive filter units for which safety tests are appropriate –  
Test methods and general requirements**

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**IEC 60939-2 edition 2.1 contains the second edition (2005-02) [documents 40/1510/FDIS and 40/1537/RVD], its corrigendum (2005-11) and its amendment 1 (2023-08) [documents 40/3059/FDIS and 40/3072/RVD].**

**In this Redline version, a vertical line in the margin shows where the technical content is modified by amendment 1. Additions are in green text, deletions are in strikethrough red text. A separate Final version with all changes accepted is available in this publication.**



International Standard IEC 60939-2 has been prepared by IEC technical committee 40: Capacitors and resistors for electronic equipment.

This second edition constitutes a technical revision.

The major changes that have been made between the first and the second edition are :

- Capacitance and  $\tan \delta$  measurements, d.c. line resistance or voltage drop at rated current, impulse voltage, passive flammability, current overload, solvent resistance of marking, component solvent resistance and active flammability have been added to Clause 4, test and measurement procedures.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

IEC 60939 consists of the following parts, under the general title *Passive filter units for electromagnetic interference suppression*

- Part 1: Generic specification
- Part 2: Sectional specification: Test methods and general requirements
- Part 2-1: Blank detail specification – Passive filter units for electromagnetic interference suppression – Filters for which safety tests are required (Assessment level D / DZ)
- Part 2-2: Blank detail specification – Passive filter units for electromagnetic interference suppression – Filters for which safety tests are required (Safety tests only)

The committee has decided that the contents of this document and its amendment will remain unchanged until the stability date indicated on the IEC website under [webstore.iec.ch](http://webstore.iec.ch) in the data related to the specific document. At this date, the document will be

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# PASSIVE FILTER UNITS FOR ELECTROMAGNETIC INTERFERENCE SUPPRESSION –

## Part 2: Sectional specification – Passive filter units for which safety tests are appropriate – Test methods and general requirements

### 1 General

#### 1.1 Scope

This Sectional specification applies to passive filter units for electromagnetic interference suppression which fall within the scope of the Generic Specification IEC 60939-1:2010.

The scope of this Sectional specification is restricted to passive filter units for which safety tests are appropriate. This implies that filters specified according to this Sectional specification will either be connected to mains supplies, when compliance with the mandatory tests of Table 3 is necessary, or used in other circuit positions where the equipment specification prescribes that some or all of these safety tests are required.

This Sectional specification applies to passive filter units which will be connected to an a.c. mains or other supply with a nominal voltage not exceeding 1 000 V a.c., with a nominal frequency not exceeding 400 Hz, or 1 000 V d.c.

#### 1.2 Normative references

[IEC 60939-2:2005](#)

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

NOTE Components other than inductors and capacitors in the filter unit should fulfil requirements in the relevant IEC Standard.

IEC 60060-1, *High-voltage test techniques – Part 1: General definitions and test requirements*

IEC 60062, *Marking codes for resistors and capacitors*

IEC 60068-1, *Environmental testing – Part 1: General and guidance*

IEC 60068-2-17, *Basic environmental testing procedures – Part 2: Tests – Test Q: Sealing*

IEC 60085, *Thermal evaluation and classification of electrical insulation*

IEC 60335-1:2020, ~~Safety of~~ *Household and similar electrical appliances – Safety – Part 1: General requirements*

IEC 60384-14:2023, *Fixed capacitors for use in electronic equipment – Part 14: Sectional specification: Fixed capacitors for electromagnetic interference suppression and connection to the supply mains*

IEC 60664 (all parts), *Insulation coordination for equipment within low-voltage systems*

IEC 60939-1:2010, *Passive filter units for electromagnetic interference suppression – Part 1: Generic specification*

IEC 60940, *Guidance information on the application of capacitors, resistors, inductors and complete filter units for radio interference suppression*

IEC 61140, *Protection against electric shock – Common aspects for installation and equipment*

### **1.3 Information to be given in a detail specification**

#### **1.3.1 General**

The detail specifications shall be derived from the relevant blank detail specification.

Detail specifications shall not specify requirements inferior to those of the generic, sectional or blank detail specification. When more severe requirements are included, they shall be listed in 1.9 of the detail specification, and indicated in the test schedules, for example by an asterisk.

NOTE The information given in 1.3.2 may, for convenience, be presented in tabular form.

The following information shall be given in each detail specification and the values quoted shall preferably be selected from the appropriate clause of this sectional specification.

#### **1.3.2 Outline drawing and dimensions**

There shall be an illustration of the filter as an aid to easy recognition and for comparison of the filter with others. Dimensions and their associated tolerances, which affect interchangeability and mounting, shall be given in the detail specification. All dimensions shall preferably be stated in millimetres.

Normally, the numerical values shall be given for the length of the body, the width and height of the body and the wire spacing, or for cylindrical types, the body diameter and the length and diameter of the terminations. When necessary, for example when a range of filters is covered by a single detail specification, their dimensions and their associated tolerances shall be placed in a table following the drawing.

In addition, the detail specification shall state such other dimensional information as will adequately describe the filter outline.

#### **1.3.3 Mounting**

The detail specification shall specify the method of mounting recommended for normal use and the method which is mandatory for the application of the vibration, bump, shock and endurance tests. The design of the filter may be such that special mounting fixtures or heat sinks are required in its use. In this case, the detail specification shall describe the mounting fixtures and they shall be used in the application of the vibration, bump or shock tests. The specified heat sink shall be used in the application of the endurance test.

If recommendations for mounting for "normal" use are made, they shall be included in the detail specification under 1.8 "Additional information (not for inspection purposes)". If they are included, a warning can be given that the full vibration, bump and shock performance may not be available if mounting methods other than those specified in 1.1 of the detail specification are used.

#### **1.3.4 Ratings and characteristics**

##### **1.3.4.1 General**

The ratings and characteristics shall be in accordance with the relevant clauses of this specification.

**1.3.4.2 Particular characteristics**

Additional characteristics may be listed when they are considered necessary to specify adequately the filter for design or application purposes.

**1.3.5 Marking**

The detail specification shall specify the content of the marking on the filter and the package.

**1.4 Terms and definitions**

For the purposes of this Sectional specification, the terms and definitions given in 2.2 of IEC 60939-1:2010, as well as the following apply.

**1.4.1**

**a.c. mains filter (or mains filter)**

passive filter unit designed essentially for application with a power-frequency alternating voltage supplied from the mains

**1.4.2**

**class X capacitor**

capacitor of a type suitable for use in situations where failure of the capacitor would not lead to danger of electric shock but could result in a risk of fire.

Class X capacitors are divided into three subclasses (see Table 1) according to the peak voltage of the impulses superimposed on the mains voltage to which they may be subjected in service. Such impulses may arise from lightning strikes on outside lines, from switching in neighbouring equipment, or switching in the equipment in which the capacitor is used.

**Table 1 – Classification of class X capacitors**

Subclass	Peak pulse voltage in service	IEC 60664 insulation category	Application	Peak impulse voltage $U_p$ applied before endurance test
X1	> 2,5 kV ≤ 4,0 kV	III	High pulse application	when $C_R \leq 1,0 \mu\text{F}$ : $U_p = 4,0 \text{ kV}$ when $C_R > 1,0 \mu\text{F}$ : $U_p = \frac{4}{\sqrt{C_R \times 10^6}} \text{ kV}$
X2	≤ 2,5 kV	II	General purpose	when $C_R \leq 1,0 \mu\text{F}$ : $U_p = 2,5 \text{ kV}$ when $C_R > 1,0 \mu\text{F}$ : $U_p = \frac{2,5}{\sqrt{C_R \times 10^6}} \text{ kV}$
X3	≤ 1,2 kV	-	General purpose	none

**1.4.3**

**class Y capacitor**

capacitor or RC-unit of a type suitable for use in situations where failure of the capacitor could lead to danger of electric shock.

Class Y capacitors are further divided into ~~four~~ three subclasses, Y1, Y2, ~~Y3~~ and Y4, as shown in Table 2.

~~(IEC 60384-14, 1.5.4)~~

**Table 2 – Classification of class Y capacitors**

Subclass	Type of insulation bridged	Range of rated voltages	Peak impulse voltage before endurance test
Y1	Double insulation or reinforced insulation	≤ 500 V	8,0 kV
Y2	Basic insulation or supplementary insulation	≥ 150 V ≤ 300 V	5,0 kV
Y3		≥ 150 V ≤ 250 V	none
Y4		< 150 V	2,5 kV

**NOTE** – For definitions of basic, supplementary, double and reinforced insulation, see IEC 61140.

Subclass	Type of insulation bridged	Range of rated voltages	Peak impulse voltage $U_p$ applied before endurance test	
Y1	Double insulation or reinforced insulation	≤ 500 V	8,0 kV	
Y2	Basic insulation or supplementary insulation	≥ 150 V ≤ 500 V	$C_N \leq 1,0 \mu\text{F}$	$C_N > 1,0 \mu\text{F}$
			5 kV	$U_p = \frac{5}{\sqrt{\frac{C_N}{10^{-6}}}} \text{ kV}$
Y4	Basic insulation or supplementary insulation	< 150 V	2,5 kV	

Y2 capacitors may be substituted by Y1 capacitors of the same or higher  $U_R$ .

**NOTE 1** For definitions of basic, supplementary, double, and reinforced insulation, see IEC 61140.

**NOTE 2** The factor used for the reduction of  $U_p$  for capacitance values above 1,0  $\mu\text{F}$  maintains  $0,5 \times C_N U_p^2$  constant for these capacitance values;  $C_N$  is in F.

**NOTE 3** Overvoltage categories in association with rated impulse voltage and rated mains voltage are found in IEC 60664-1.

One Y1-capacitor may bridge double insulation or reinforced insulation.

The enclosure of a Y1-capacitor shall not contain other components.

Assemblies, like Delta by-pass or T-connected by-pass capacitors, may be constructed from Y-capacitors and X-capacitors provided these capacitors fulfil the requirements for the relevant X and Y subclasses.

One Y-capacitor may bridge basic insulation. One Y-capacitor may bridge supplementary insulation. If combined basic and supplementary insulations are bridged by two or more Y2-, Y3- or Y4-capacitors in series, they **must** shall have the same class and sub-class, the same rated voltage, and the same nominal capacitance value.

~~For guidance on the application of capacitors bridging basic insulation, see 6.1 of IEC 60940.~~

#### 1.4.4 earth inductor

inductor that forms part of the earth lead of a filter

## 1.5 Marking

**1.5.1** See 2.4 of IEC 60939-1:2010 with the following details:

The information given in the marking is normally selected from the following list; the relative importance of each item is indicated by its position in the list:

- a) manufacturer's name or trademark;
- b) manufacturer's type designation or the type designation given in the detail specification;
- c) recognised approval mark;
- d) rated voltage and rated frequency;
- e) identification of terminations and/or circuit diagram;
- f) rated current;
- g) rated temperature;
- h) climatic category;
- i) year and month (or week) of manufacture (if the indication is in code, it shall be the code given in IEC 60062);
- j) reference to the detail specification.

**1.5.2** The filter shall be clearly marked with the information in 1.5.1 a), b), c), d) and f), and also e) if this is not implied by b).

**1.5.3** The package containing the filter(s) shall be clearly marked with all the information listed in 1.5.1.

National approvals may be indicated by lettering as an alternative to the approval mark.

**1.5.4** Any additional marking shall be so applied that no confusion can arise.

## 2 Preferred ratings and characteristics

### 2.1 Preferred characteristics

#### 2.1.1 General

The values given in detail specifications should preferably be selected from the following:

#### 2.1.2 Preferred climatic categories

The filters covered by this specification are classified into climatic categories according to the general rules given in IEC 60068-1.

The lower and upper category temperature and the duration of the damp heat, steady state test should be chosen from the following:

Lower category temperature: –65 °C, –55 °C, –40 °C, –25 °C or –10 °C;

Upper category temperature: +70 °C, +85 °C, +100 °C, +125 °C or +155 °C;

Duration of the damp heat, steady state test: 21 or 56 days.

The severities for the cold and dry heat tests are the lower and upper category temperatures respectively.

For guidance on the application of the categories described above, see IEC 60940.

## 2.2 Preferred values of ratings

### 2.2.1 Rated voltage ( $U_R$ )

The preferred values of rated voltage are:

115 V, 125 V, 250 V, 400 V, 440 V, 500 V and 760 V.

Electromagnetic interference suppression filters shall be chosen to have a rated voltage equal to or greater than the nominal voltage of the supply system to which they are connected. The design of the filters shall take into account the possibility that the voltage of the system may rise by up to 10 % above its nominal voltage.

NOTE X-capacitors can be used in a star connect.

### 2.2.2 Category voltage ( $U_C$ )

The category voltage is equal to the rated voltage unless otherwise stated in the detail specification.

### 2.2.3 Rated temperature

The rated temperature shall not be less than +40 °C.

### 2.2.4 Passive flammability

When specified, the minimum category of passive flammability permitted is category C.

## 3 Quality assessment procedures

### 3.1 Primary stage of manufacture

See 3.2 of IEC 60939-1:2010.

### 3.2 Structurally similar filters

See 3.4 of IEC 60939-1:2010.

In addition to these provisions, filters may be considered as structurally similar only when for their range of component values they have the same capacitor, inductor and resistor technologies and corresponding capacitive elements are of the same subclass.

### 3.3 Certified records of released lots

The information required in 3.5.1 of IEC 60939-1:2010 shall be made available when prescribed in the detail specification and when requested by a customer. After the endurance test, the parameters for which variables information is required are insertion loss change and insulation resistance.

### 3.4 Approval testing

#### 3.4.1 Safety tests only approval

Table 3 and Annex B form a schedule limited to tests concerning safety only requirements. The schedule to be used for safety only approval will be on the basis of fixed sample sizes according to 3.4 of IEC 60939-1:2010 as given in 3.4.3 and Table 3 of this Sectional specification. Prior to the approval testing being carried out, it is necessary to submit to the certification body a declaration of design (Annex E) registering essential data and basic design details of the passive filters for which approval is sought.